

# ARD

## Councils

natural waste water treatment

# ARM Group Ltd

## natural wastewater treatment



Whether you're thinking about a new reed bed system, or you just want some timely expert advice about effective operation, we can help.



### Harnessing natural technology

**E**ver since natural waste water treatment systems came of age in the 1980s, ARM Ltd has led the way in reed bed and constructed wetland technology.

Working with the UK water companies, councils, contractors, industrial clients and research institutes, we have designed, built and maintained many hundreds of reed bed systems. These range in size from 10m<sup>2</sup> up to 20,000m<sup>2</sup>, and we have consulted on reed beds of many hundreds of hectares.

Harnessing natural processes, we engineer them to deliver all the advantages of cost-effective, versatile and sustainable wastewater treatment – and we guarantee the performance of every system we design and install.

As the largest dedicated UK company by far in this specialised field, with a reputation dating back to 1947, ARM brings you unique expertise and experience. We can support you at every stage of the process – from initial planning and design through construction and commissioning to ongoing maintenance – ensuring the optimum performance of your reed bed system.

We continue to pioneer new and innovative ideas. Recent developments include an aggregate recycling system to reduce landfill costs and material usage, and a plough to retrofit FBA™ airlines into existing reed beds.

### Why use reed beds?

**T**he Chinese used wetlands more than two thousand years ago for their impressive effluent and water treatment capabilities.

Reed beds provide an ideal environment for a wide range of treatment processes. The combination of micro-organisms, plant roots, rhizomes and substrate matrix remove contaminants in a variety of natural ways.

They treat waste water as it flows through the system just like the process in conventional sewage treatment, but without using energy-intensive machinery.

With low maintenance requirements,

low or zero power consumption and a long, productive lifespan, reed bed systems are both proven and sustainable, enhancing any landscape. Their removal mechanisms include settlement, filtration, biological and chemical action, containment and plant uptake. They can reduce levels of soluble organic matter, suspended solids, ammonia, pathogens, hydrocarbons, and metals.

The various types of reed bed can be used in different configurations to treat a variety of pollutants from industrial or municipal sources.

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## Performance guaranteed

**O**ur reed beds are used at all stages of the sewage treatment process providing primary, secondary and tertiary treatment as well as sludge dewatering.

They can also extend the life of older treatment works by providing a tertiary polish to effluent, bringing it within regulator consent, and saving capital expenditure.

They are increasingly used for tackling industrial effluent. Uses range from treating fire-fighting foam and metal removal from minewater drainage, to reducing ammonia levels in leachate and removing hydrocarbons from groundwater.

Other applications include treatments connected with:

- agriculture
- pharmaceutical
- food processing
- chemicals
- refinery waste
- distillery wastewater
- airport run off
- Sustainable Urban Drainage Systems (SUDS)

They can also be used to create wetland habitats – enhancing bio-diversity.

*Whatever the application, we provide contractual guarantees of effectiveness, performance and quality – so you can be sure you're going to get the results you're looking for.*



## Our comprehensive range of services includes:

**Consultancy:** feasibility studies, process design, site surveys, landscape design, and advice on managing future changes

**Project management:** our experienced managers will look after your entire project from conception through to completion.

**Design and build:** our turnkey service delivers systems on time and within budget, including liaising with regulators and enforcement authorities on your behalf.

**Design and supply of materials and equipment:** a service we provide on request, for example to framework contractors.

**Construction service:** using our design or your own, we make it easy for contractors and save our clients significant amounts of money through design reviews based on experience – without compromising quality or performance.

**Field services for system maintenance:** we extend the life of your system, bring you peace of mind and help you get the best possible results.

**Asset assessment:** we evaluate process efficiency, check your system is operating at top performance, and make recommendations.

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# ARM Group Ltd

## About Us



ARM Group Ltd, a Staffordshire based privately owned company, is the leading designer and constructor of natural waste water treatment systems and associated technologies for the industrial and municipal waste water treatment market in the UK. The Company is noted for its invention and subsequent commercial development of equipment and processes within its chosen markets.

ARM Group Ltd has been trading since 1947 and was originally involved in development, design, manufacture, and construction within Agricultural Engineering. However, in the late 1980s ARM Group Ltd redefined its objectives and moved its customer and product bases into the global market of wastewater treatment specialising in the use of reed bed/wetland systems.

Today the Company operates out of offices in Rugeley, Staffordshire employing 21 people and using Associates and sub-contractors as required.



ARM Group Ltd is broadly divided into seven operating functions these can provide client support either individually, as a team, incorporating the requisite elements, or as a whole providing continuity of support for turnkey solutions from project conception through design construction, commissioning and maintenance, depending on the specific needs of the client. The functions are:

- Sales
- Design
- Project management
- Construction
- Research and Development
- Refurbishment and Maintenance
- Administration





## Experience

For the past 30 years ARM Group Ltd have specialised in reed bed and wetland systems having designed and installed over 700 beds during this period. This provides us with unique and extensive experience of their application, design and construction across the wastewater treatment spectrum. Our experience and knowledge has been accumulated through:

- Design and construction of reed bed systems
- Value engineering optimisation
- Application experience
- Working with academic institutions.
- The international constructed wetlands conference circuit
- Presenting papers
- Personal contact with leading researchers
- Working relationships with leading specialist in specific reed bed applications
- Founder member of the Constructed Wetland Association (CWA)
- Founder member of Global Wetland Technology (GWT)
- Over 1000 reed bed surveys

We have designed and constructed reed beds that provide treatment for:

- Mine water
- BOD and COD reduction
- Methanol removal
- Copper removal
- Pathogens
- Landfill leachate
- Hydrocarbons
- Septic tank waste
- Ammonia
- Surface water run off
- Solids
- Sludge dewatering
- Storm water
- Metals
- Glycol



# Llanfair PG, Wales

## Passive vertical downflow: Secondary sewage



### Project

Llanfair PG, Cheshire  
County Council

### Location

The Conway Centre

### Project Type

Design and construct

### Wastewater Type

Secondary sewage

### Completion Date

2009

### Treatment System

Passive vertical flow  
reed bed

### Needs

The Conway Centre in Llanfair PG is owned and run by Cheshire County Council as a residential and day arts and outdoor education facility. It is set in idyllic National Trust parkland on the Island of Anglesey in North Wales. The centre is primarily for students and pupils from schools and colleges in Cheshire though other organisations use the facility. For many years the wastewater generated on site was discharged post settlement into the Menai Straits adjacent to the centre relying on dilution as a means of effluent management. Conscious of their environmental responsibilities and that this was an educational establishment Cheshire County Council felt that a more appropriate method of effluent management should be used on the site and were keen to select as sustainable solution as possible. Their environmental consultants, Peak Associates requested ARM Ltd to design and install a suitable reed bed treatment solution.

More than 21,000 children and adults attend the centre each year and there are 420 beds on site making it one of the largest residential arts and educational centres in the UK.

FLOW AND LOADS		INFLUENT AVERAGE	DISCHARGE CONSENT
Flow	(m <sup>3</sup> /d)	55	–
BOD	(mg/l)	400	40
Suspended Solids	(mg/l)	300	60

The measured loads and consents are outlined in the table above.



## Llanfair PG, Wales



### Solution

The treatment solution had to be positioned near to the rear of the main accommodation building in line with the existing sewerage infrastructure where there was limited available space. The National Trust also specified that a specific distance be maintained from mature trees in this area. Trial pits were dug to establish the position of the existing effluent pipes. These were taken into consideration in the new treatment reed bed design and subsequently required minimal alteration. Because there was little available land a passive vertical flow reed bed was selected as the most appropriate solution. This allowed us to adjust the dimensions of the bed to fit the available space. ARM Ltd installed a 60 m<sup>3</sup> two

stage settlement tank, specified by others, followed by a bed of 440 m<sup>2</sup>.



### Benefits

The reed bed treatment installation provided Cheshire County Council with an improved, robust and sustainable treatment solution for the Conway Centre. The reed bed also became a feature for the centre being used as an example of sustainable technology development and application for children and others attending courses.

# National Botanic Garden of Wales

## Saturated vertical flow: Secondary sewage



### Project

National Botanic Garden of  
Wales, Camarthanshire

### Location

Llanarthne, Camarthenshire

### Project type

Upgrade existing works

### Wastewater type

Sewage

### Completion date

August 2010

### Treatment

Saturated vertical flow system  
with FBA™

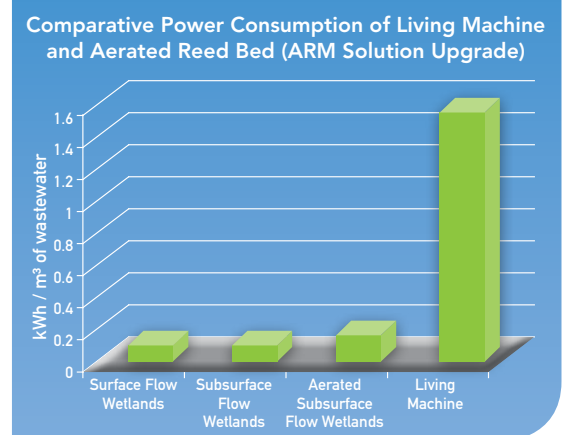
## Need

The National Botanic Garden of Wales (NBGOW) is a Millennium Commission Capital Project situated in the grounds of an old estate. In 1998 a wastewater treatment system was installed comprising a septic tank, aeration tanks, a Living Machine® package treatment system and a reed bed. This aging system had a high energy consumption and the design was insufficient to cope with increased visitor numbers. The existing system required upgrading to treat the peak flows of 40m<sup>3</sup> per day, 2000 visitors and 90 members of staff per day whilst reducing energy costs.

## Solution

NBGOW design philosophy is that all wastes generated on site should be treated on site, and that the systems need to be designed to cope with peak loads associated with holiday seasons. ARM were commissioned to provide design optimisation and upgrade the existing system.

The Living Machine® and aeration tanks were decommissioned. The existing 128m<sup>2</sup> vertical flow reed bed was refurbished and retrofitted with Forced Bed Aeration™ (FBA) technology. The reed bed now receives flows directly from the septic tank, and will reduce BOD, Suspended Solid concentrations. The additional aeration in the system increases the oxygen availability to provide conditions suitable for nitrification which will remove ammonia.



## Benefits

The upgraded reed bed system with FBA™ has a greater treatment capability and has smaller foot print than the previous system and saves around £7,000 in energy and maintenance costs per year.





# Resolis, Highland Council

## Horizontal subsurface flow reed beds, secondary sewage



### Project

Resolis Primary School,  
Highland Council

### Location

Cullicudden, Black Isle

### Project type

Design and construct

### Wastewater type

Secondary sewage

### Completion date

April 2007

### Treatment

Two horizontal flow reed beds flow beds

### Need

The Highland Council constructed a school on the Black Isle near Cullicudden known as Resolis Primary School. Sewage effluent from the school was to pass through a

septic tank and secondary treatment system prior to discharging back into the environment via a

water course. The discharge consents for the secondary treatment element were not excessive and the council were keen to use as sustainable treatment solution as they could. The table above indicated the predicted flows and loads.

	INFLUENT (MG/L)	UPPER TIER CONSENTS (MG/L)	LOWER TIER CONSENTS (MG/L)
BOD	384	<50	20
Suspended Solids	450	<100	25
Ammonia	-	-	-
Flow (m <sup>3</sup> /d)	10	10	10



There was land available for a reed bed towards the south of the school beyond the playing field adjacent to where the septic tank was to be situated.

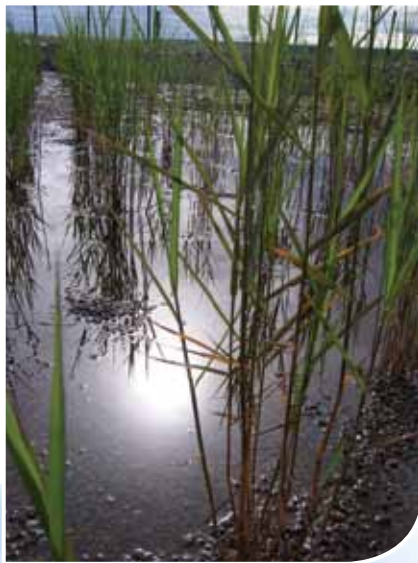




## Solution

The discharge permit did not specify an ammonia consent so a two bed horizontal subsurface flow wetland treatment system was selected as the most technically and economically effective solution at Resolis. The available land dictated that the beds should lie end to end but operate in parallel. A connection was made to the septic tank discharge and a splitter chamber was constructed to divide the flow from the septic tanks equally between the two reed beds. Each bed had an area of 200 m<sup>2</sup> totalling 400 m<sup>2</sup>. The reed bed was to also be an educational resource

for the school highlighting the use of sustainable technologies. It was, however, important to provide fencing around the system due to the proximity of the playground to the treatment system. Access to the reed beds was only allowed under close adult supervision.



## Benefits

The reed bed installation at the Resolis Primary School provided the local council with a sustainable, robust treatment solution for the new school and the children attending the school with awareness of the choices between standard and more sustainable technological solutions.



# St Michaels Golf Course

## Aerated saturated vertical flow reed bed: Landfill leachate



### Project

St Michaels Golf Course,  
Halton Borough Council

### Location

Widnes, Cheshire

### Project type

New build

### Wastewater type

Landfill leachate

### Completion date

April 2013

### Treatment

Aerated saturated  
vertical flow

### Need

St Michaels Golf Course is located to the west of Widnes town centre. It occupies an area of 45 hectares and was built on a capped landfill site which was used for the deposition of local chemical industry and domestic wastes. The golf course was constructed in stages between 1974 and 1986. In October 2004 Halton Borough Council (HBC) closed the golf course on the advice of the Health Protection Agency following the discovery of high concentrations of Arsenic in near surface soils.

The land was subsequently classed as Contaminated Land due to the arsenic and the potential of harm to humans and pets and discharge of a polluting leachate into the local Stewards Brook.

Remediation measures included the capping of the land with clean soils to prevent access to contaminated soils including a capillary break layer and the installation of a leachate collection system to prevent potentially polluting leachate from entering Stewards Brook. As a temporary measure the collected leachate was pumped and transported off site for disposal at a licensed Waste water treatment works (WwTW).

HBC were keen to install a long term sustainable and cost effective solution to treat the collected leachate once it was fully characterised. Following the commissioning of feasibility studies by Amec and Land and Water, including ARM Ltd, it was concluded that the most viable, cost effective and sustainable solution for managing the leachate was the use of aerated vertical flow reed beds for treatment of the leachate prior to discharge to sewer.





	Inlet			Discharge consents
	Minimum	Maximum	Average	Average
Flow rate (m <sup>3</sup> /day)	19	91	48	–
BOD (mg/l)	–	–	38	<5
Suspended solids (mg/l)	–	–	107	<15
Ammonia (mg/l)	–	–	1.1	<1
Sulphide (mg/l)	5	93	19	<1
Sulphate (mg/l)	–	–	–	<1446

The flow and loads of the leachate to be treated are given to the left along with the consents to discharge to sewer set by the local Water Company.

## Solution

If the leachate were to be discharged to the water course (Stewarts Brook) then an Arsenic

consent would be enforced and an anaerobic first stage reed bed would be needed. Because the leachate can be discharged to foul sewer none is needed and the aerated vertical flow system will suffice.

The Key contaminant for removal in the leachate is sulphide though the BOD reduction also needed to be factored into the solution. The mechanism of action is oxidation of the sulphide to sulphate under aerobic conditions which would also support aerobic degradation of the BOD and ammonia. An aerated saturated vertical flow system was selected as the optimum treatment solution. This provides adequate aeration for oxidation as well as effective surface mixing of the anaerobic effluent into the aerated effluent within the bed. A 195m<sup>2</sup> reed bed was constructed to treat leachate collected in a holding tank on site and to discharge treated leachate into the local sewer.



## Benefits

The installation of the aerated reed bed system provided a means of long term low maintenance; low carbon footprint leachate treatment on site saving the significant ongoing costs associated with tankering the leachate off site. Other benefits are listed below

- Economically viable due to the relatively low capital and operational costs
- An effective treatment with high durability and long term performance that will achieve an effluent that will comply with the Discharge Consent Compliance Criteria to foul sewer
- A sustainable treatment option which produces relatively little waste/by-product in-situ
- Low maintenance requirements
- Adjustable treatment to accommodate varying concentrations and throughput
- A fully warranted design with performance guarantees.



# Forced Bed Aeration (FBA)

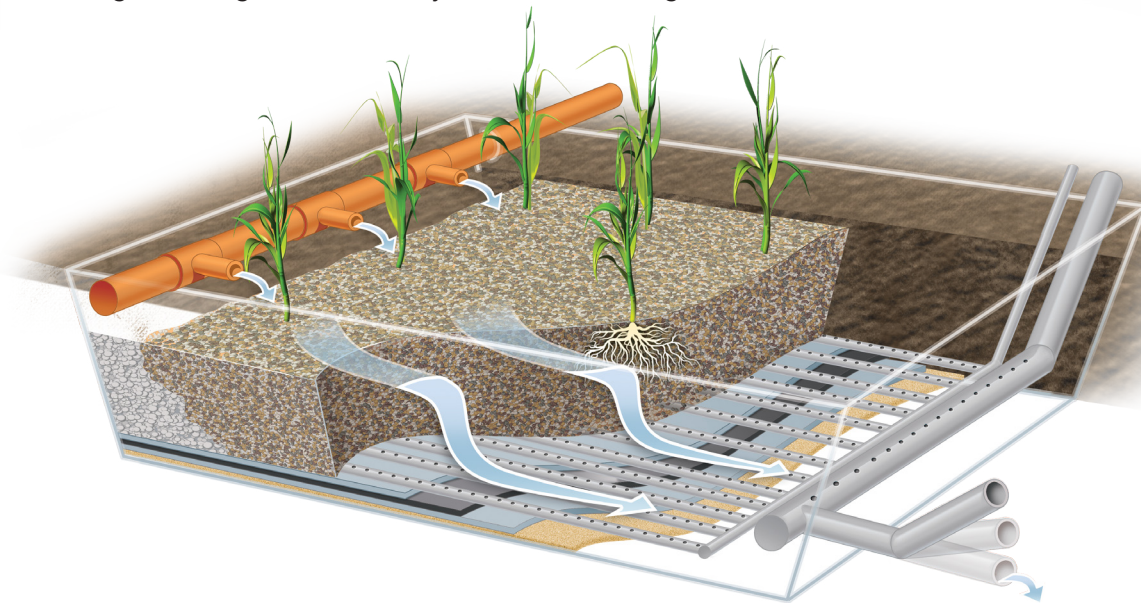
Forced Bed Aeration™ compliments and enhances existing reed bed technology, increasing treatment capacity by up to 15 times.



**F**orced Bed Aeration™ (FBA™) is a new wastewater treatment technology which enhances constructed wetland treatment performance. Significantly higher contaminant removal rates are attained along with an increased consistency of performance. Developed in the USA, by our partners Naturally Wallace, FBA™ can be used in both horizontal and vertical flow constructed wetland systems. Blowing air through the wetland system

makes the system oxygen unlimited increasing the treatment capacity by up to 15 times. This new technology can treat wastewaters high in BOD, SS, NH<sub>4</sub>-N and other organic contaminants.

Forced Bed Aeration™ reed beds can reach performance levels which have been unobtainable in standard reed bed systems with less performance variability. Aeration of horizontal and vertical flow reed beds has multiple advantages.



natural waste water treatment

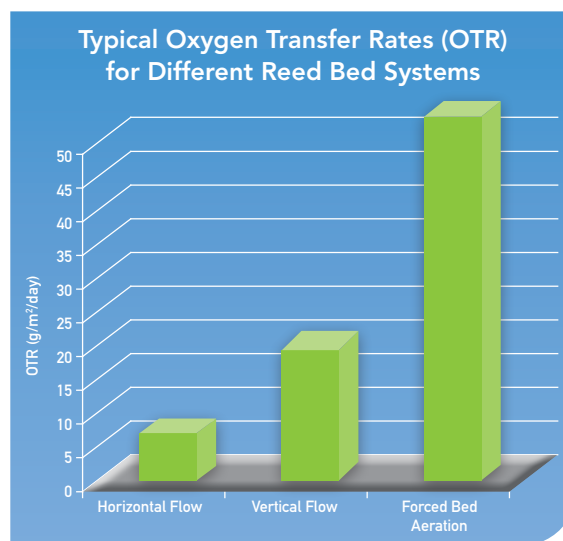


- FBA™ can completely nitrify wastewater
- FBA™ systems can be deeper than conventional reed beds therefore taking up 50% less space than passive systems.
- Plants thrive in FBA™ systems because the introduced oxygen prevents the formation of toxic products that can stunt plant growth in strongly anaerobic, passive system
- FBA™ reed beds can be divided into aerobic and anoxic zones to both nitrify and denitrify.
- FBA™ reed beds are ideal for treating fluctuating loads such as CSO's and locations with variable occupancy.
- Initial studies indicate FBA™ systems have reduced clogging rates extending the operational life of a treatment system.

technology prevents root rhizomes penetrating the emission points.

### Adapting FBA™

FBA™ can be retrofitted to existing reed bed systems, especially those which are overloaded. This prolongs the life of the reed bed and enhance effluent treatment.

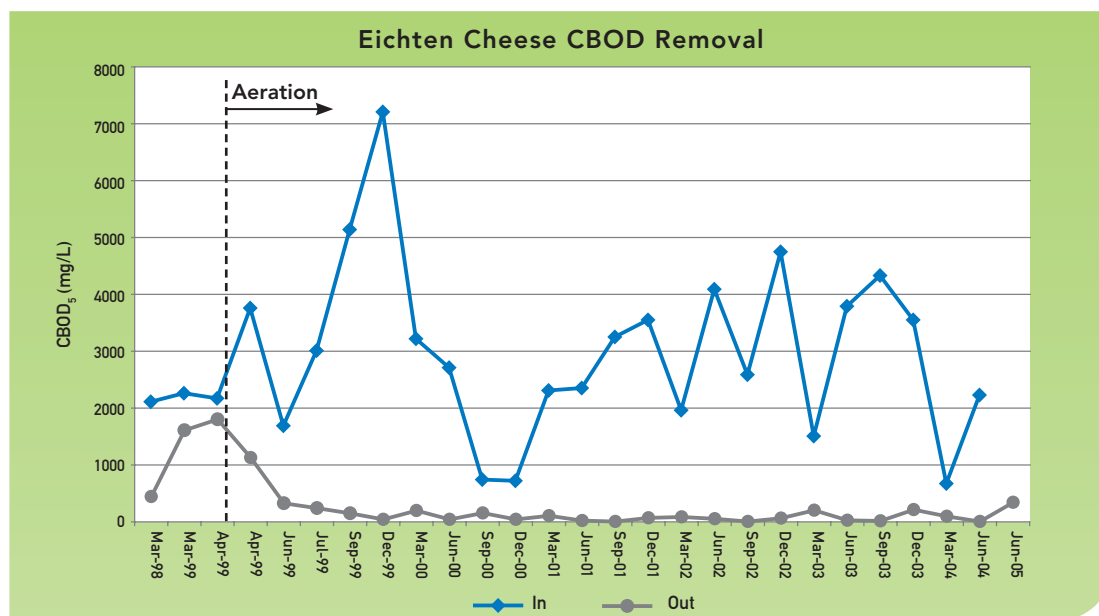


### Pipelines

FBA™ has a unique network of pipelines which provides a constant flow of oxygen into the reed bed. Patented rootguard

### FBA™:

- Improves treatment capability.
- Reduces clogging rates.
- Requires minimum power input.



Graph indicating the treatment performance of an FBA™ wetland system treating cheese production effluent

natural waste water treatment

## Asset Assessment & Support Package

Knowledge and proactive management of assets is a key area where water companies can cut operational and capital expenditure. The optimisation and enhancement of remote reed bed treatment systems can secure performance for many years without the need for full site refurbishment and the associated costs.

natural wastewater treatment



In the September 2012 issue of *Water & Wastewater Treatment* it was reported by the editor that knowledge by the majority of water companies of the condition of their assets is poor. According to the report from the consultancy company E C Harris, some 90% of maintenance in the UK water industry is reactive. Yet it is well known that proactive maintenance will cut costs by upwards of 50%.

Although this is not the case with all water companies we thought it would be an ideal opportunity to offer a simple solution. ARM Ltd have been designing, constructing, refurbishing and retrofitting reed beds for many of the UK's water companies

for decades. It is for this reason we feel best placed to offer you our new Asset Assessment and Support Package (**AASP**).

Reed beds are generally tucked away in Sewage Treatment Works and because they provide treatment with minimal maintenance requirements often get overlooked until the works are close to breaching consent. Our Asset Assessment and Support Package will highlight the condition of the system and give an indication of when refurbishment may be required. This allows expenditure to be planned and therefore controlled and ensures the works performs to its full capability.



Our Asset Assessment and Support Package works in two ways:

## 1. Asset Assessment

### Visual Appraisal

- Condition of the reeds
- Extent of sludge build up on and in the gravel matrix
- Condition of the flow path
- Site layout and accessibility
- Photographic evidence

### Fitness for Purpose

- Review design basis, 'as built' drawings and O & M Manual
- Review current and future loads and recent performance data

### Monitoring program

- Sampling and monitoring program to include influent flows/loads and discharge levels to characterise performance

### Reporting

- Verbal and written report of the assessment complete with conclusions, recommendations and indicative prices of any required remedial work

## 2. Support Service

- Asset longevity prediction
- Sampling and monitoring to establish performance
- Refurbish to 'as built'
- Re-engineering to improve performance
- Maintenance
- System operation
- Retrofit with latest technologies to enhance capability

We would be happy discuss any aspects of this service with you and can be contacted at [info@armgrouppltd.co.uk](mailto:info@armgrouppltd.co.uk) or telephone on 01889 583811.